



SCIENTIFIC DATA SYSTEMS

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INTERDATA '65

SDS AT INTERDATA '65

From the SDS 92, the first commercial computer using monolithic integrated circuitry and one of six SDS general-purpose digital computers, to complex, real-time computer-controlled systems, SDS provides a complete line of digital computing equipment. At Interdata '65, SDS is demonstrating the SDS 9300 general-purpose computer and the SDS DES-1 Differential Equation Solver.

The block diagram in Figure 1 shows the SDS equipment on display. This includes the SDS 9300 computer, the DES-1 console, line printer, card reader, strip chart recorder, magnetic tape transport, and the exclusive SDS MAGPAK cartridge-loaded magnetic tape system. Each MAGPAK Transport Pair is the logical equivalent of four conventional magnetic tape transports. Transfer rate is 1500 IBM-compatible characters per second (6 bits plus parity), and storage capacity is 6,000,000 characters.

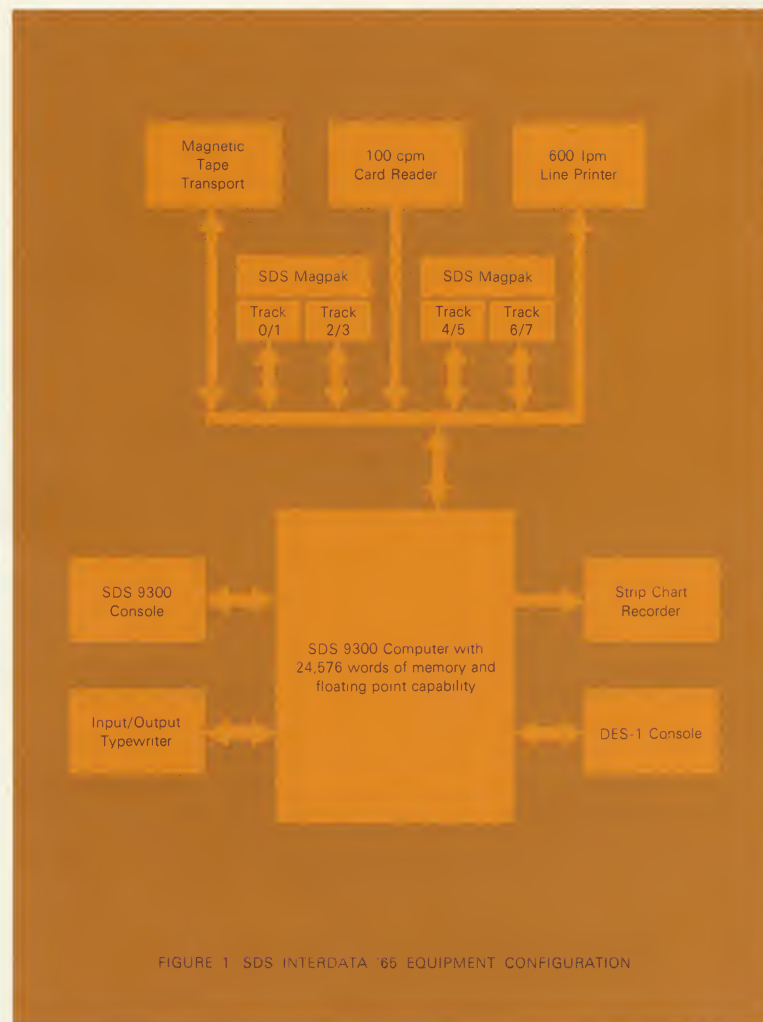


FIGURE 1 SDS INTERDATA '65 EQUIPMENT CONFIGURATION

SDS 9300

The SDS 9300 is the largest SDS general-purpose computer. It is a 24-bit machine with a 1.75-microsecond memory cycle time. Memory is expandable to 32,768 words, all directly addressable. The 9300's addressing scheme permits multiple level indirect addressing with indexing at any level at no increase in execution time.

The SDS 9300 System operates under control of the SDS MONITOR executive program. MONITOR is an extremely flexible operating system that minimizes operator intervention and improves operating efficiency and reliability. It includes input/output routines, a comprehensive set of diagnostics, and an open-ended set of processors that includes FORTRAN IV, META-SYMBOL, and the SDS Business Language.

Batch Processing □ During the demonstration, the 9300 automatically processes two jobs, loading all compilers, subroutines, source programs, and data, and compiling

and executing the programs without manual intervention.

The first of these jobs is a Matrix Inversion program written in FORTRAN IV. Under MONITOR control, the 9300 loads the FORTRAN IV compiler and necessary subroutines from the magnetic tape transport. The source program enters the computer from one of the MAGPAK cartridges. MAGPAK is also used for temporary and object code storage. The line printer lists the machine language code and original and inverted matrices.

When the first program has been executed, MONITOR automatically begins processing the next program, which is written in the SDS Business Language.

This second job assembles and executes a program to search a random file and produce a printout of the file records in a predetermined sequence. The complete program including control and execution instructions is contained on 11 cards.

The source program, Figure 2, is read into the computer from cards, and the random list from one of the MAGPAK information channels. The line printer prints the



machine language code, the random list, and the sorted list.

Although we have used a list of 100 names for this demonstration, this same program can be used with a list of virtually any size (for example, all the names in the New York City telephone directory).

Real-Time Interrupts □ While these jobs are being processed, the SDS 9300 also recognizes real-time system interrupts simulated by special pushbuttons on the computer console. This interrupt capability enables the computer to control or be controlled by its external environment.

Up to 1024 channels of priority interrupt are available with the SDS 9300. Each channel has a unique priority and location in memory, and each can be selectively armed or disarmed under program control. The computer always processes the highest active interrupt and returns to the main program only when all interrupts have been processed. This feature insures that external events are processed in order of their importance rather than in the chronological order in which they occur.

SDS DES-1

The SDS DES-1 Differential Equation Solver represents a new approach to the solution of simulation problems involving differential equations. It provides the ease of communication and on-line problem-modification abilities of an analog computer as well as the accuracy, reliability, decision-making capability, and problem repeatability of a digital computer. The DES-1 offers the first economical solution to a substantial class of large, nonlinear simulation problems. Those experienced with either analog or digital computers can easily learn to operate the DES-1.

Built around the SDS 9300 computer, the DES-1 includes a special operator's console, a mathematical operator language, and a programming system. The operator's console permits on-line monitoring and control of problems during solution. The mathematical operator language facilitates communication, enabling the user to work directly from differential equations or

LABEL	OPERATION	OPERAND
ΔJOB	SJCCJOB2	
ΔMETASPEC	SI, LO, GO	
EXTEND		
TOP	GET	NEXTNAME, EOFEXIT
	ENTER	NEXTNAME, NAMETABLE
	GOTO	TOP
EOFEXIT	SORT	NAMETABLE, NENT, 8, 1, 4, SORTED NAMETABLE
	LIST	NAMETABLE, SORTED NAMETABLE
	EXIT	
	INCLUDE	
	END	

FIGURE 2. SOURCE PROGRAM

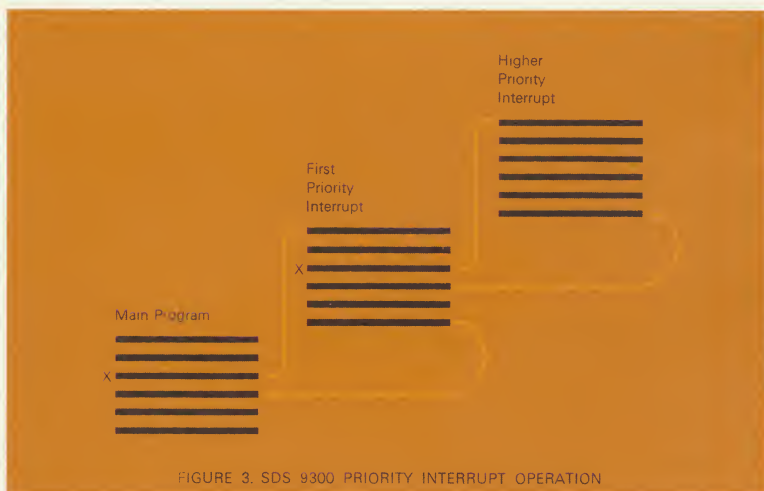
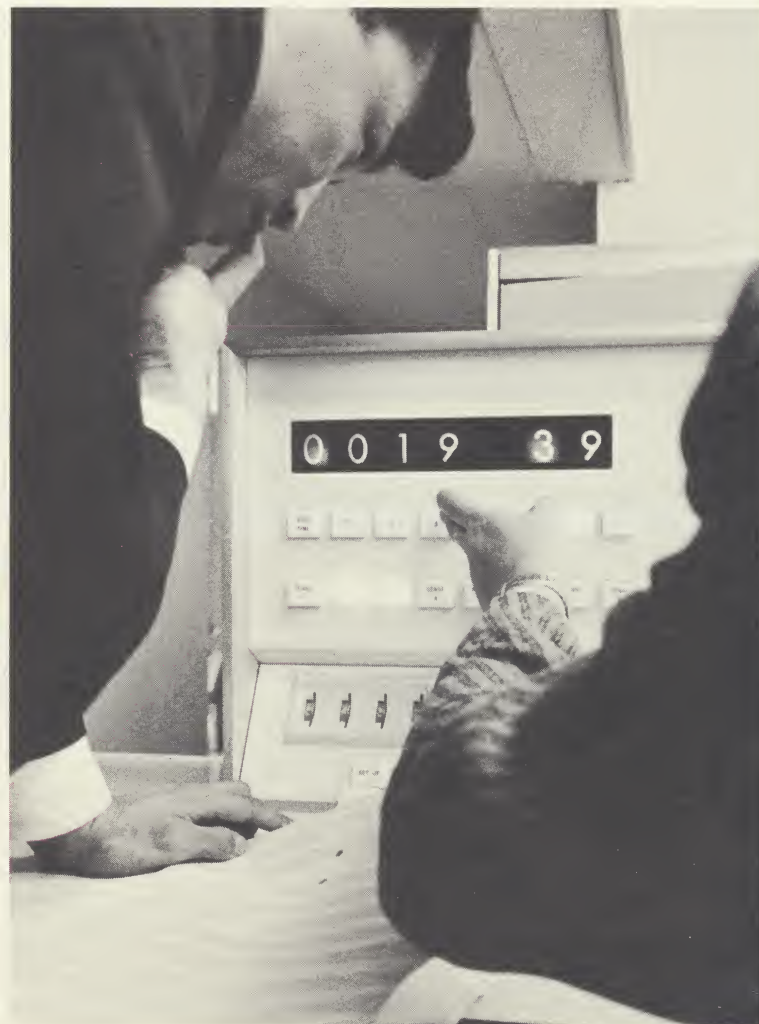


FIGURE 3. SDS 9300 PRIORITY INTERRUPT OPERATION



a block diagram in setting up and solving his problem.

During this demonstration, the DES-1 simulates the performance of a horizontal stabilizer control system for a supersonic aircraft, changing conditions within the control system and varying the type of controller used.

The position of the aircraft's horizontal stabilizer is controlled from the cockpit by the pilot. The desired horizontal stabilizer position is set on the DES-1 console, simulating the pilot input, and is compared with the actual stabilizer position obtained by a simple linear (analog) controller. An electro-hydraulic actuator moves the horizontal stabilizer to the desired position. The problem involves analyzing inaccuracies in the control system that cause an error and time delay in the degree of control obtained. We first examine the control system with different gain values for the linear controller and then replace it with a time-optimal (digital) controller.

Figure 4 illustrates the control system as it would be described by the simulation engineer using DES-1 block diagram notation. The shaded area in the diagram indicates the simple linear controller that is replaced by a

time-optimal controller later in the problem by changing a sense switch on the console. The figures in white on the diagram indicate the problem variables that are changed and examined during solution: "C" represents the desired horizontal stabilizer position set from the console; "K" is the gain constant in the continuous controller; "E" is the error or difference between the desired and actual positions of the horizontal stabilizer; and "R" is its actual position.

Working from the block diagram, the engineer prepares his problem for DES-1 solution using the DES-1 operator language with its familiar terminology. This problem required only 74 statements. To express the same problem in a conventional digital computer language such as FORTRAN would require more than 100 statements.

The problem is read into the computer from cards. Values for C and K are set and varied by means of potentiometers on the DES-1 console. A sense switch on the console is used to substitute the time-optimal controller.

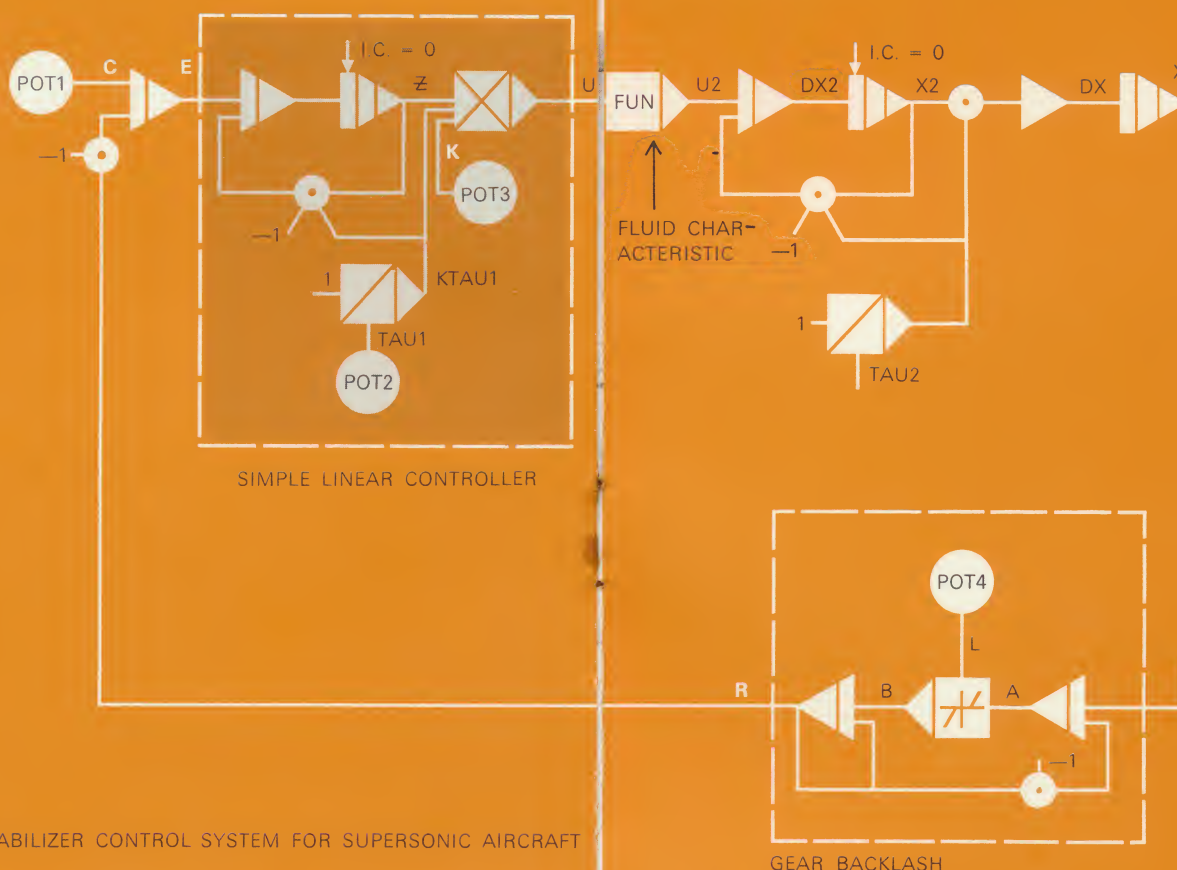


FIGURE 4. STABILIZER CONTROL SYSTEM FOR SUPERSONIC AIRCRAFT

A strip chart recorder shows the desired and actual horizontal stabilizer positions and the position error (see Figure 5) for each set of conditions. During problem solution, the engineer also obtains an instantaneous visual readout of important problem variables.

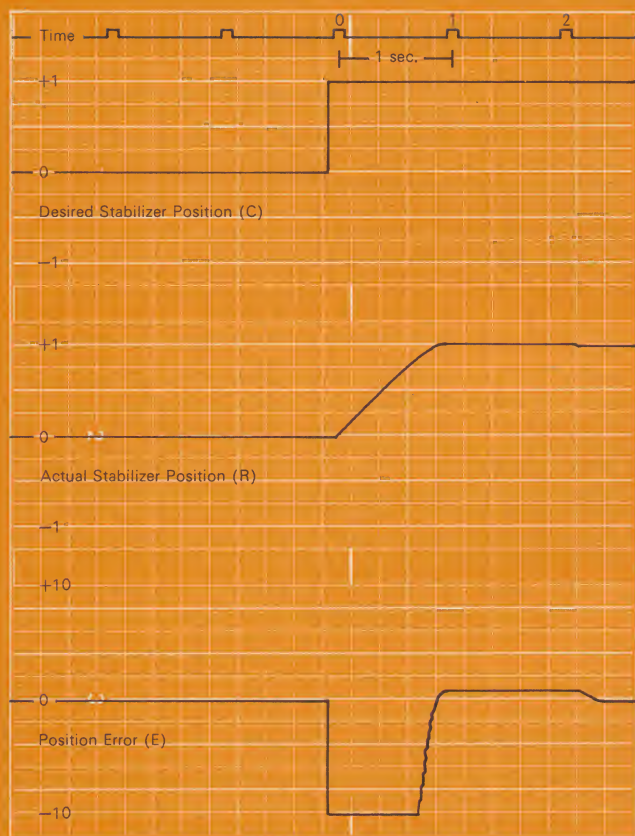


FIGURE 5. STRIP CHART RECORDER OUTPUT